REMARKS

This paper amends the specification and Claims 1 and 12, and adds new Claims 27-29. Claims 2-11 and 13-26 are unchanged. Claims 1-29 are pending. Reconsideration and allowance of the claims is respectfully requested. The amendment of Claims 1 and 12 is not narrowing and is not made to avoid any prior art.

Discussion of Objections to the Specification

The Office Action states that "[f]rom pages 2-23, there are numerous instances of words containing superscripts with no corresponding references for them". Applicant respectfully submits that the references are listed on pages 25-27 of the originally filed specification in a section having the heading "References".

The Office Action states that "[o]n pages 15-17, Figure 1 is discussed along with its corresponding components, but no reference numerals from the drawings are cited". Applicant respectfully submits that the components of Figure 1, including reference numerals, are described in paragraph [0048] beginning on page 9. Applicant has amended paragraphs [0065] and [0066] to add the reference numerals corresponding to the components of Figure 1 discussed therein.

Claims 1 and 12 were objected to because of informalities. Applicant has amended Claims 1 and 12 to correct the informalities and clarify the claims.

Discussion of the Rejection of Claims under 35 U.S.C. § 102(e)

Claims 1-26 have been rejected under 35 U.S.C. § 102(e) as being anticipated by Nambu (U.S. Patent No. 6,801,626).

Claim 1

Nambu discloses a quantum cryptographic network having a sender unit which has an encoder distributing a raw key consisting of a random bit sequence encoded on a coherent light pulse (see Nambu, Claim 1). However, Nambu uses a discrete (binary) modulation (see column 3, lines 40-46). The bit sequence (consisting of "0" and "1") is encoded into 0 degree and 180 degree phase shift. Applicant's Claim 1 recites in part: "at least one sending unit comprising an encoder and configured to distribute a raw key in the quadrature components of quantum

coherent states that are continuously modulated in phase and amplitude". The continuous modulation in phase and amplitude (as described on page 4, paragraph [0015] and pages 8-9, paragraph [0045]) is in direct contrast to the discrete modulation used in the network of Nambu. The term "continuous" can refer to real number being encoded (see for example, Claim 14 where "random numbers x_A and p_A" are recited) into a corresponding phase shift and amplitude. The phase shift and amplitude can thus attain any value within a chosen range, and therefore, the modulation can be continuous (see also page 16, 3rd last line to page 17, 2nd line).

Applicant's security analysis uses Gaussian-modulated coherent states. Shannon's information theory for Gaussian channels makes it possible to estimate the maximum amount of information a potential eavesdropper may gain. Hence, an "all-continuous" strategy is used in the present system in which the encoding (Gaussian modulation) and decoding (homodyne detection) both involve real numbers and not binary digits (bits).

Additionally, Applicant's system uses a standard laser source which is attenuated and modulated in phase and amplitude, as recited in Claims 1 and 12. Applicant's system does not require the use of a non-linear crystal (optical transducer) as in Nambu's network, which would make the realization of the scheme quite difficult, if not impossible. In the abstract and Nambu's independent Claim 9, it is stated that an "optical transducer" is used for transforming the (second) coherent light pulse sequence into a superposition of coherent light states. The resulting superposition is depicted in Figure 4C. Nambu's network entirely relies on the ability to produce such superpositions of quantum states as evidenced by its recitation in Claim 1 of Nambu. Applicant does not need, make use of, or claim the use of superpositions of coherent states.

Therefore, Applicant respectfully submits that the rejection has been overcome and requests prompt allowance of the claim.

Claim 14

Applicant's Claim 14 recites in part: "selecting, at a sender, two random numbers x_A and p_A from a Gaussian distribution of mean zero and variance $V_A N_0$, where N_0 refers to the shot-noise variance". The Office Action states that this is anticipated by Nambu at column 9, line 60 through column 11, line 12. At column 9, lines 60-61 of Nambu, it is stated: "The following is a

detailed description of the homodyne detection of the present invention". The homodyne detection is performed at a receiver and not at a sender (see e.g., Claim 5 of Nambu). The cited portion of Nambu's patent indeed concerns Gaussian distribution, but the Gaussian probability distribution referred to by Nambu concerns the detection of the quantum states and not the selection of them.

Nambu discloses a random bit sequence of light pulses which are discretely modulated into quantum states $|\alpha\rangle$ and $|-\alpha\rangle$ at a receiver site (column 10, lines 4-10). A Gaussian probability distribution on both discrete quantum states is invoked by Nambu in order to check for potential eavesdropping (column 10, lines 11-17). From Figures 4A-4C and column 10, lines 22-57 it is clear that the measurement of one of both quantum states results in a value having a Gaussian probability distribution concentrated in a circle of radius ½ around either of the two quantum states. Each quantum state has its own Gaussian probability distribution at detection.

To the contrary, Claim 14 concerns the selection of two random numbers x_A and p_A from one Gaussian probability distribution in order to generate from these two numbers a corresponding coherent state $|x_A+ip_A\rangle$ that is sent to a receiver. This feature is not disclosed by Nambu, and therefore, Claim 14 is not anticipated by Nambu.

Therefore, Applicant respectfully submits that the rejection has been overcome and requests prompt allowance of the claim.

Claim 17

Applicant's Claim 17 recites in part: "an optical component configured to modulate the amplitude and phase of the pulses at a high frequency". In contrast, Nambu only discloses a phase modulator. Because there is no mention of an amplitude modulator in Nambu's document, Applicant respectfully deems Claim 17 as not being anticipated by Nambu.

Therefore, Applicant respectfully submits that the rejection has been overcome and requests prompt allowance of the claim.

Claim 20

Applicant's Claim 20 recites in part: "an integrated electro-optic amplitude modulator and a piezoelectric phase modulator, configured to...". In contrast, the technical feature of the "amplitude modulator" in Claim 20 is not anticipated by Nambu. Nambu's disclosure only refers to a phase modulator.

Therefore, Applicant respectfully submits that the rejection has been overcome and requests prompt allowance of the claim.

Dependent Claims

Claims 2-13, 15-16, 18-19 and 21-26 are dependent either directly or indirectly on the above-discussed independent claims. Applicant respectfully submits that pursuant to 35 U.S.C. § 112, ¶4, the dependent claims incorporate by reference all the limitations of the claim to which they refer and include their own patentable features, and are therefore in condition for allowance. Therefore, Applicant respectfully requests the withdrawal of all claim rejections and prompt allowance of the claims.

New Claims

New Claims 27-29 have been added. Claim 27 is supported by at least paragraph [0013] on page 3 of the specification. Claim 28 is supported by at least paragraph [0010] beginning on page 2 of the specification. Claim 29 is supported by at least paragraph [0010] beginning on page 2 of the specification.

Applicant respectfully submits that all new claims are patentable.

Conclusion

In view of the foregoing remarks, Applicant respectfully submits that the claims of the above-identified application are in condition for allowance. However, if the Examiner finds any impediment to allowing all claims that can be resolved by telephone, the Examiner is respectfully requested to call the undersigned.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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